Innovation for Safe and Efficient Drinking Water Supply (Adaptation)

December 2019

AGC Inc.

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Water scarcity and global warming

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- Global warming is expected to account for about 20 percent of the global increase in water scarcity this century.
- It is predicted that global warming will alter precipitation patterns around the world, melt mountain glaciers, and worsen the extremes of droughts and floods.

https://timeforchange.org/water-scarcity-and-global-warming

Fact file of WHO

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FACT FILE

World Health Organization

10 FACTS ON CLIMATE CHANGE AND HEALTH

Previous Next

1 2 3 4 5 6 7 8 9 10

WHO/Georges Bartoli

Water scarcity encourages people to transport water long distances and store supplies in their homes. This can increase the risk of household water contamination, causing illnesses.

https://www.who.int/features/factfiles/climate_change/facts/en/index6.html

Areas of Physical and Economic Water Scarcity

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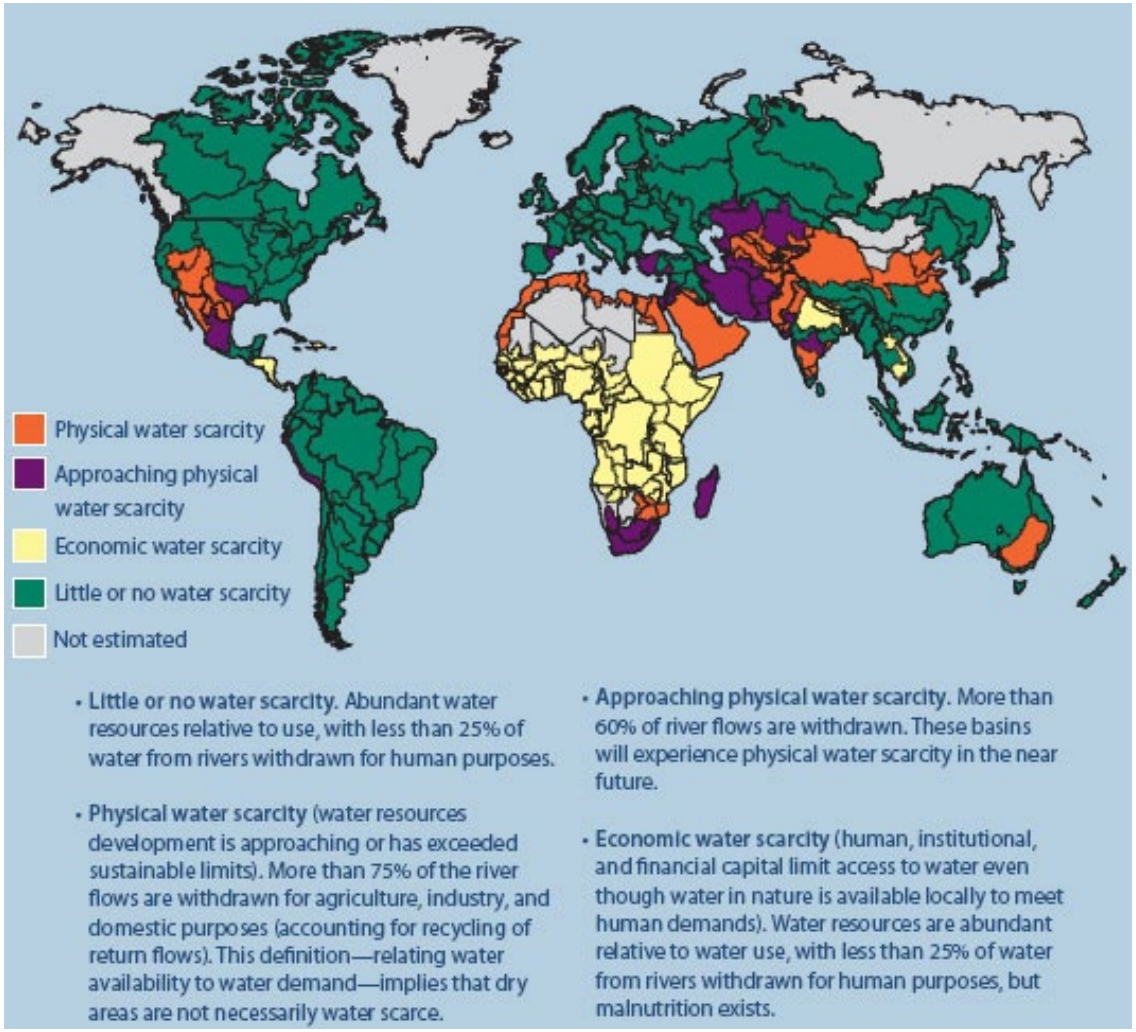

https://timeforchange.org/water-scarcity-and-global-warming

Guidelines for Drinking-water Quality

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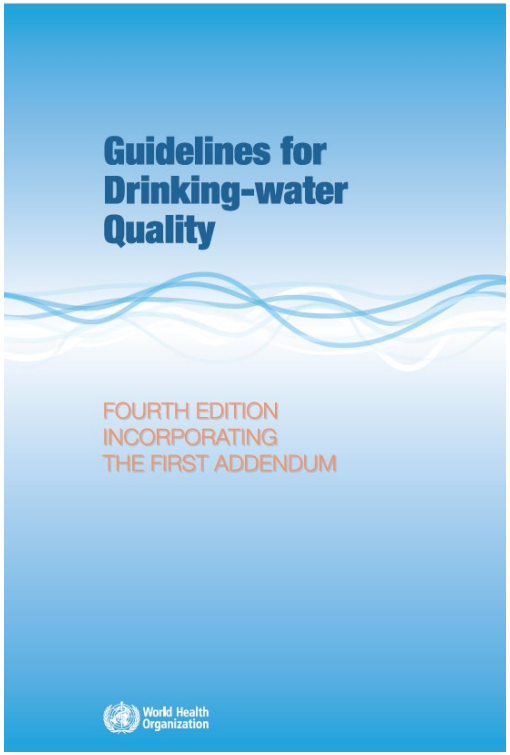
- **Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection.**



Guidelines for Drinking-water Quality 4th edition, WHO

Importance of safe drinking water

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- **Access to safe drinking-water is important as a health and development issue at national, regional and local levels.**
- **In some regions, it has been shown that investments in water supply and sanitation can yield a net economic benefit, because the reductions in adverse health effects and health-care costs outweigh the costs of undertaking the interventions.**

Guidelines for Drinking-water Quality 4th edition, WHO

Assessing the quality of drinking-water

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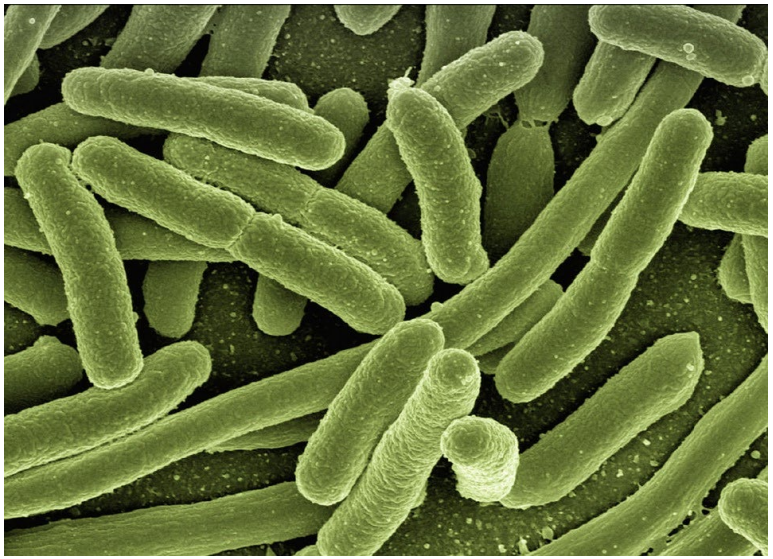
- **Microbial aspects**
- **Chemical aspects**
- **Acceptability aspects: taste, odour and appearance**

Guidelines for Drinking-water Quality 4th edition, WHO

Microbial aspects

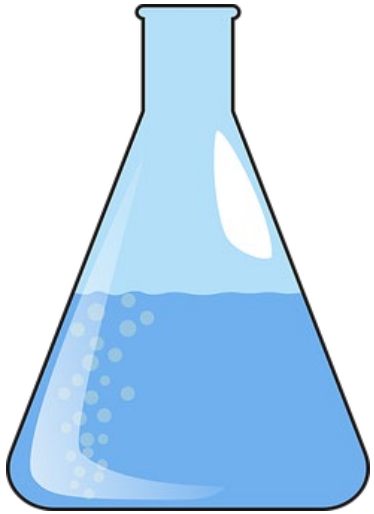
- **Securing the microbial safety of drinking-water supplies is based on the use of multiple barriers, from catchment to consumer, to prevent the contamination of drinking-water or to reduce contamination to levels not injurious to health.**



Guidelines for Drinking-water Quality 4th edition, WHO

Chemical aspects

- **The health concerns associated with chemical constituents of drinking-water differ from those associated with microbial contamination and arise primarily from the ability of chemical constituents to cause adverse health effects after prolonged periods of exposure.**



Guidelines for Drinking-water Quality 4th edition, WHO

Taste, odour and appearance

- **Water should be free of tastes and odours that would be objectionable to the majority of consumers.**
- **Microbial, chemical and physical constituents of water may affect the appearance, odour or taste of the water, and the consumer will valuate the quality and acceptability of the water on the basis of these criteria.**

Guidelines for Drinking-water Quality 4th edition, WHO

Arsenic

- In water, it is mostly present as arsenate (+5), but in anaerobic conditions, it is likely to be present as arsenite (+3).
- However, in waters, particularly ground-waters, where there are sulfide mineral deposits and sedimentary deposits deriving from volcanic rocks, the concentrations can be significantly elevated.

Guidelines for Drinking-water Quality 4th edition, WHO

Fluorine

- **Fluorine is a common element that is widely distributed in Earth's crust and exists in the form of fluorides in a number of minerals, such as fluorspar, cryolite and fluorapatite.**
- **In some areas rich in fluoride-containing minerals, well water may contain up to about 10 mg of fluoride per litre, although much higher concentrations can be found.**

Guidelines for Drinking-water Quality 4th edition, WHO

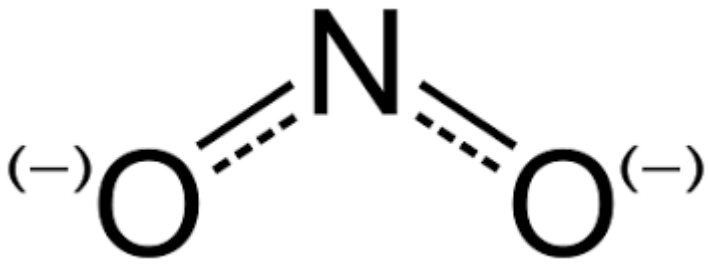
Iron

- **Iron is one of the most abundant metals in Earth's crust. It is found in natural fresh waters at levels ranging from 0.5 to 50 mg/l. Iron may also be present in drinking-water as a result of the use of iron coagulants or the corrosion of steel and cast iron pipes during water distribution.**

Guidelines for Drinking-water Quality 4th edition, WHO

Nitrate and Nitrite

- Nitrate (NO_3^-) is found naturally in the environment and is an important plant nutrient.
- It is present at varying concentrations in all plants and is a part of the nitrogen cycle.
- Nitrite (NO_2^-) is not usually present in significant concentrations except in a reducing environment, because nitrate is the more stable oxidation state.



Guidelines for Drinking-water Quality 4th edition, WHO

Total dissolved solids

- **The palatability of water with a total dissolved solids (TDS) level of less than about 600 mg/l is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.**

Guidelines for Drinking-water Quality 4th edition, WHO

Treatment Methods for chemicals

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There are many methods for chemicals such as:

- **Air stripping**
- **Coagulation**
- **Ion exchange**
- **Precipitation softening**
- **Activated carbon**
- **Ozonation**
- **Advanced oxidation Membranes**
- **Biological treatment**
- **UV irradiation etc.**

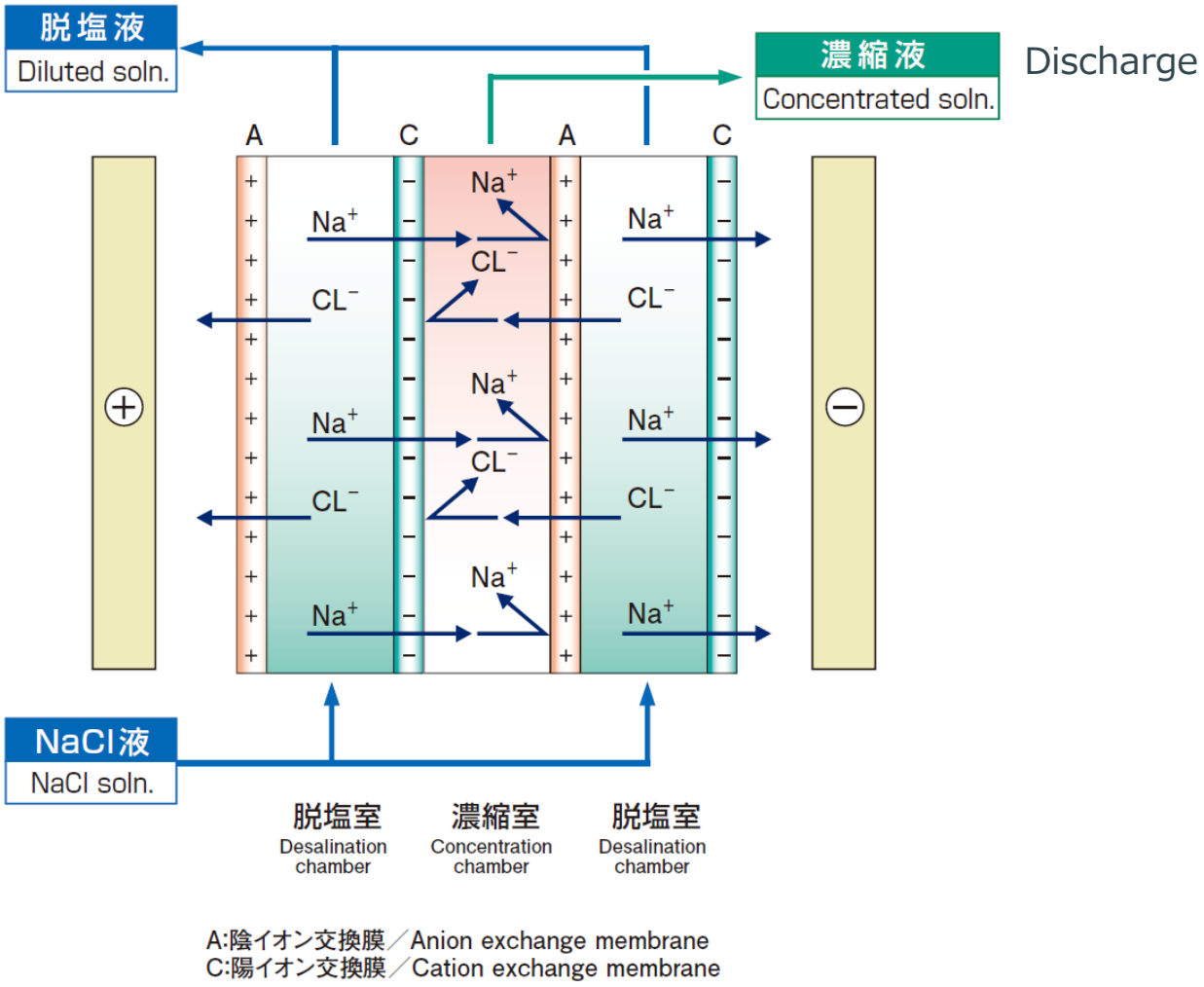
Guidelines for Drinking-water Quality 4th edition, WHO

Electrodialysis (ED)

- ED is a kind of “Ion exchange” method.
- ED is used to transport salt ions from one solution through ion-exchange membranes to another solution under the influence of an applied electric potential difference.
- This is done in a configuration called an Electrodialysis cell.

Description of ED

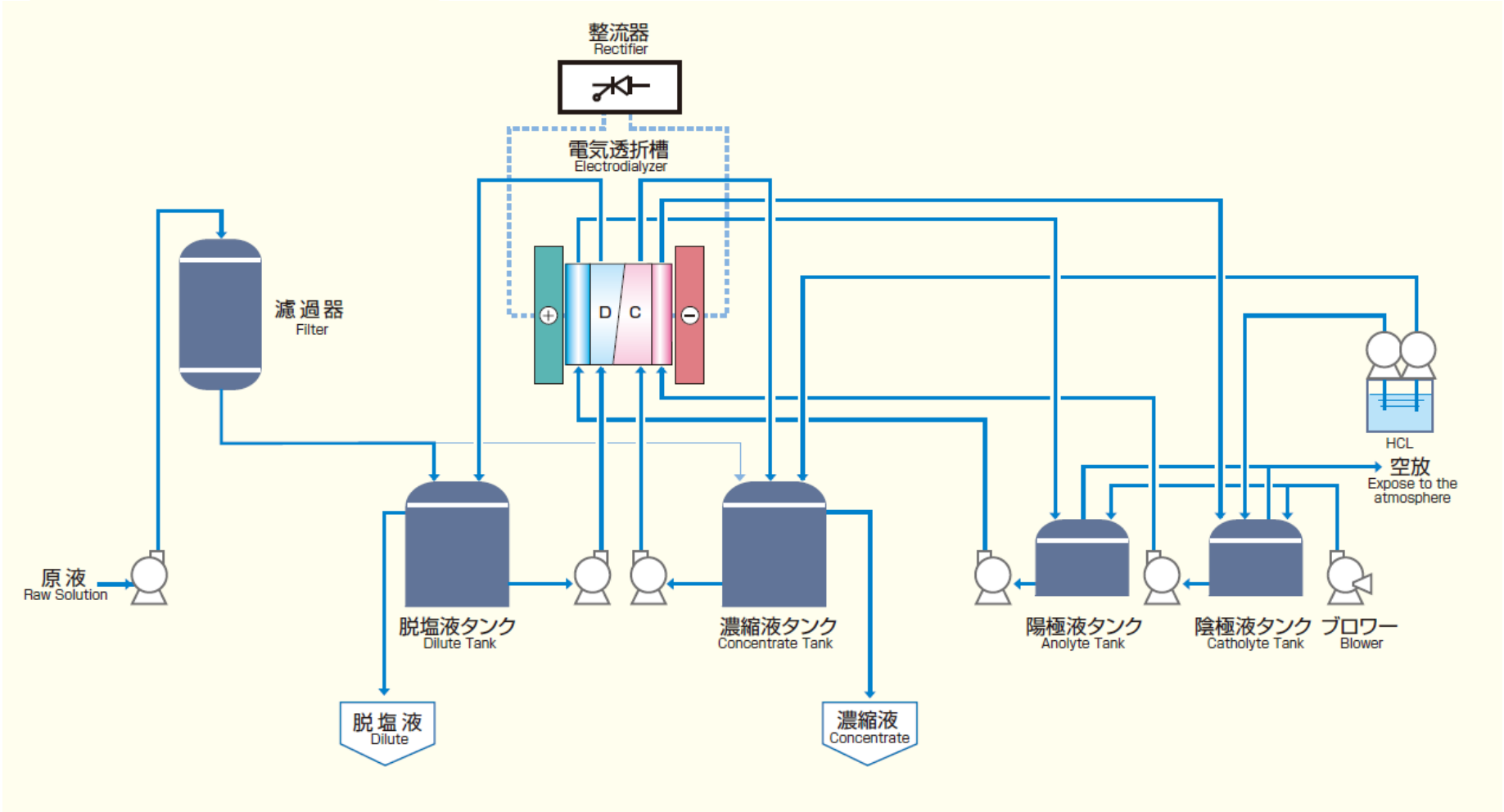
Drinking water



Contaminated water

A:陰イオン交換膜／Anion exchange membrane
C:陽イオン交換膜／Cation exchange membrane

ED process flow



Actual equipment

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Applications of ED

- Table salt production
- Demineralization in the food industry
- Industrial wastewater reclamation
- Desalination (tap water)
- Acid recovery
- Substitutional reactions

Advantages and Disadvantage

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Advantages

- **High water efficiency**
  Water reuse ratio: ≧90%
- **High energy efficiency**
  No high pressure pump required

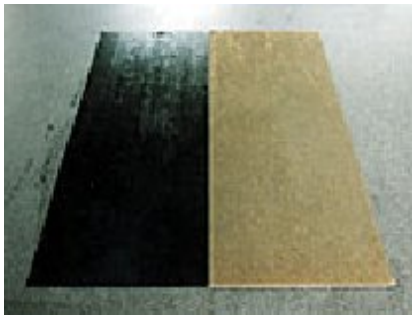
  → **Good combination with solar power**

Disadvantags

- **High initial cost**
  High quality electrodialyzer needed

  → **Challenge is to lower the initial cost by localization.**

Example of electrodialyzer



Ion-exchange membrane

Introduction of a project in India

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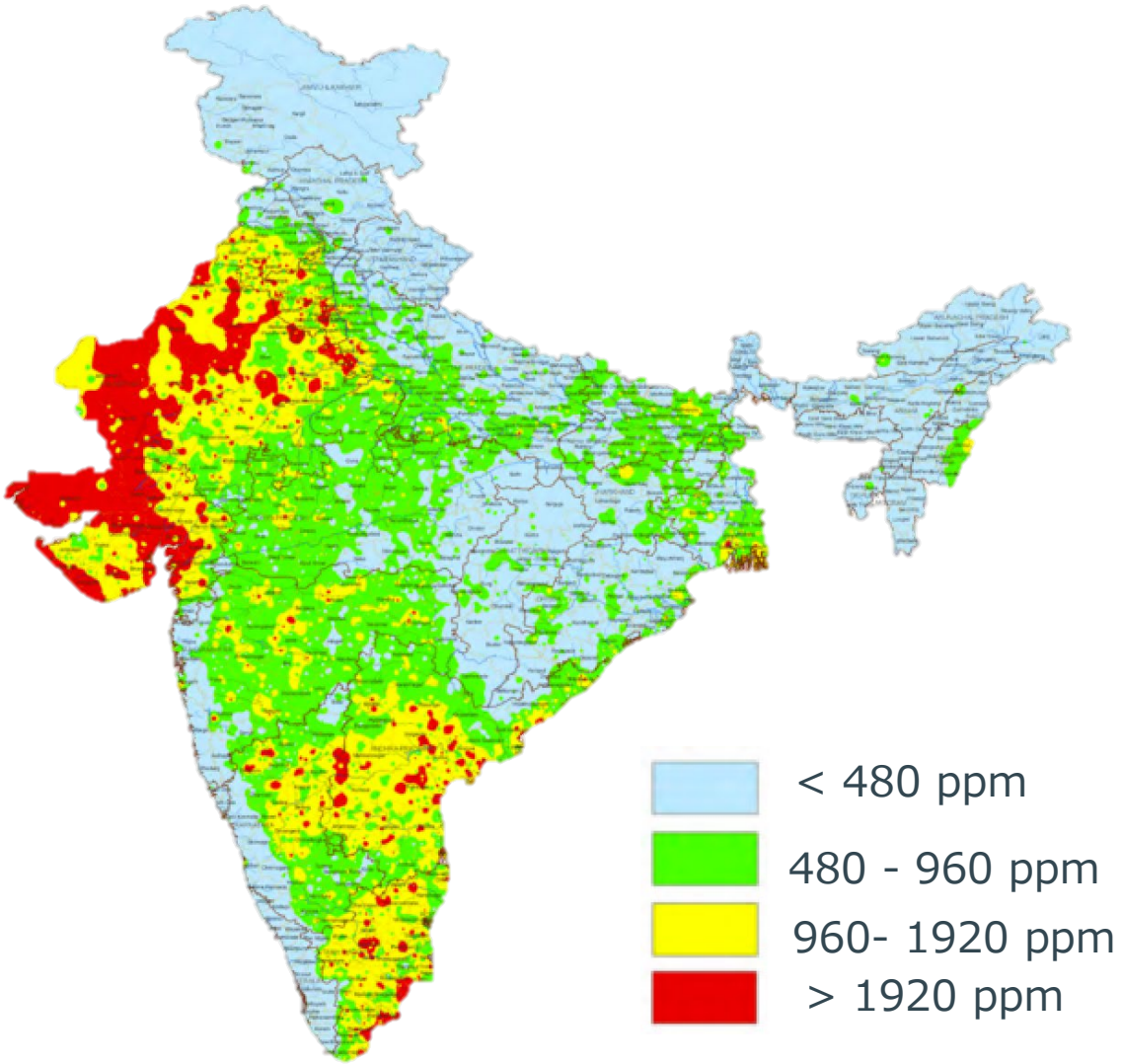
- **Challenges in India**
  - ➢**Occurrence of health damage by using polluted groundwater as drinking water**
  - ➢**Serious escalation in groundwater level down by pumping up a large amount of groundwater**

Photo: World Resource Institute

How widespread is Groundwater Salinity?



256 million people living in effected land area

11+ States effected

35% of total land area

(F. Weert, 2009) and (Central Ground Water Board, India, Annual Report, 2009-2010)

FACTLY
Making Public Data Meaningful

factlydotin www.factly.in

HOW FAR RURAL INDIA TRAVELS EVERY DAY TO FETCH DRINKING WATER ?

INDIAN AVERAGE %

35%
NEED NOT TRAVEL

42.9%
TRAVEL UPTO 0.5 KM

22.1%
TRAVEL MORE THAN 0.5 KM

WITHIN PREMISES | 0.5 KM | MORE THAN 0.5 KM

MOST ACCESSIBLE

#1 CHANDIGARH 85.4%
#2 PUNJAB 81.7%

TOP 10 STATES WITH LEAST ACCESSIBILTY

#1 MANIPUR 40.7%
#2 TRIPURA 39.6%
#3 ODISHA 38.5%
#4 MEGHALAYA 37.9%
#5 JHARKHAND 36.4%
#6 MADHYA PRADESH 36.1%
#7 MIZORAM 32.1%
#8 RAJASTHAN 31.9%
#9 WEST BENGAL 31.5%
#10 NAGALAND 31.4%

Source : Answer to Unstarred question 1757 in the Lok Sabha

Proposed product / technology

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- ED purification system using photovoltaic generation and ion exchange membrane
- Improvement of groundwater use efficiency
- Cost reduction by local production of non-core parts

Purification of Groundwater for Drinking Water

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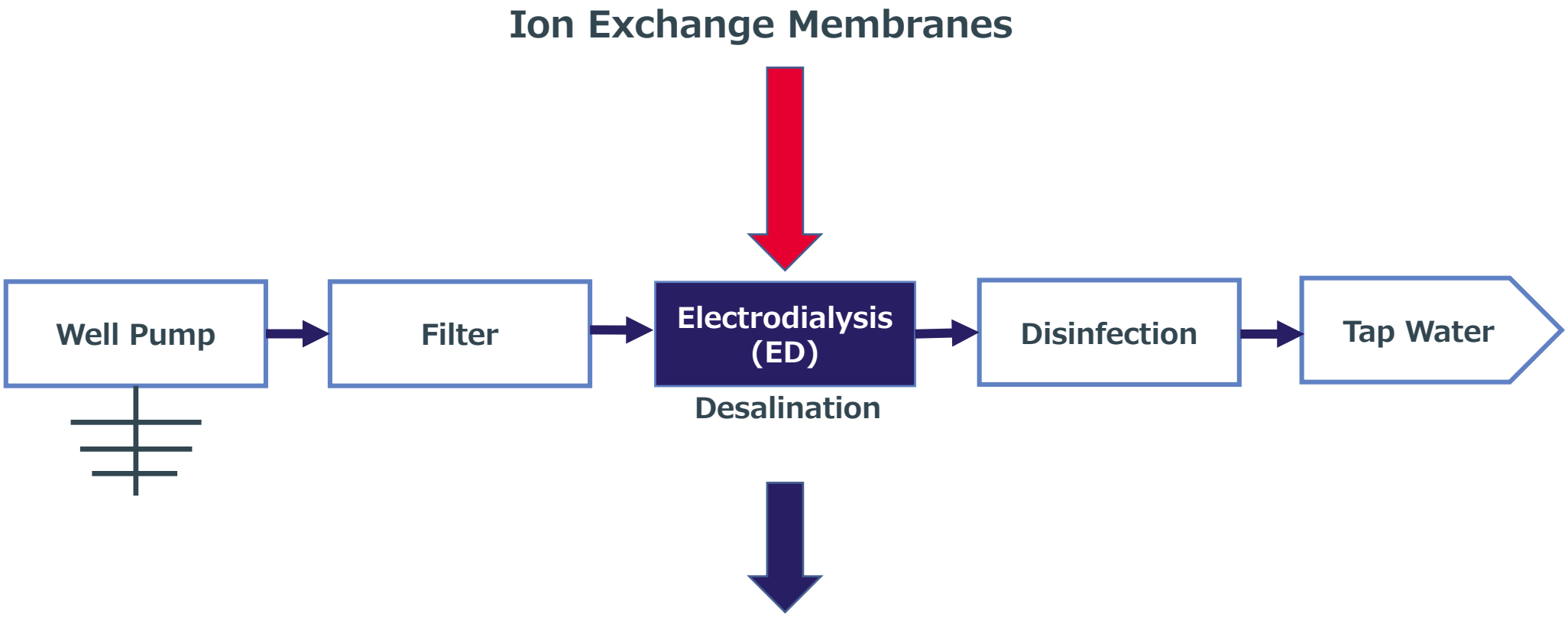

- **Separate and desalt total dissolved solids (TDS)** in groundwater
- **Decrease nitrate** in groundwater

} Safe drinking water

The key to success in India

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- Rental of water purification system to rural communities and installation of water ATM (prepaid system)
- Selling purification systems to water vending machine suppliers (EPC) and daily maintenance and maintenance (O&M)
- Providing EPC, O&M service of water purification system to bottled water manufacturers

※ EPC: Engineering, Procurement & Construction
O&M: Operation & Maintenance

Contribution to India and the World

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- Prevention of health damage by purifying groundwater contaminated with nitrate etc.
- Mitigation of groundwater level down
- Substantial improvement of groundwater use efficiency
- Achieving universal and equal access to safe and inexpensive drinking water

SDGs Business Verification Survey with the Private Sector for Electrodialysis Purification System for Safe and Efficient Drinking Water Supply
AGC Inc.（Tokyo）

Challenges in target country

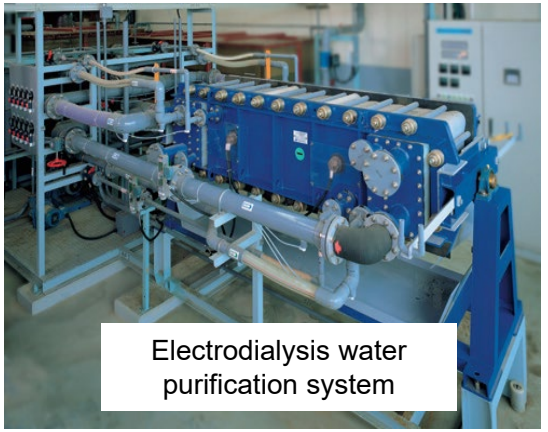
・Occurrence of health damage by using polluted groundwater as drinking water
・Serious escalation in groundwater level down by pumping up a large amount of groundwater

Proposed product / technology

・Electrodialysis purification system using photovoltaic generation and ion exchange membrane
・Improvement of groundwater use efficiency
・Cost reduction by local production of non-core parts

Contents of this project

- Contract period: July 2019 – July 2021
- Target area: India (Jalgaon Province, Maharashtra, and surrounding areas)
- Project Outline: Aim to improve access to safe and inexpensive drinking water. Introduce electric dialysis purification systems using solar power and ion exchange membranes to residents in rural areas of India where groundwater pollution and groundwater levels are becoming worse. Purification groundwater contaminated with nitrate etc. and improve water use efficiency.



Electrodialysis water purification system

Business model to achieve

・Rental of water purification system to rural communities and installation of water ATM (prepaid system)
・Selling purification systems to water vending machine suppliers (EPC) and daily maintenance and maintenance (O & M)
・Providing EPC・O & M service of water purification system to bottled water manufacturers

Contribution to issues in target countries through business development

・Prevention of health damage caused by purification of groundwater contaminated with nitrate etc.
・Mitigation of groundwater level down
・Substantial improvement of groundwater use efficiency
・Achieving universal and equal access to safe and inexpensive dinking water

Created on February 8, 2019

6th India Water week 2019

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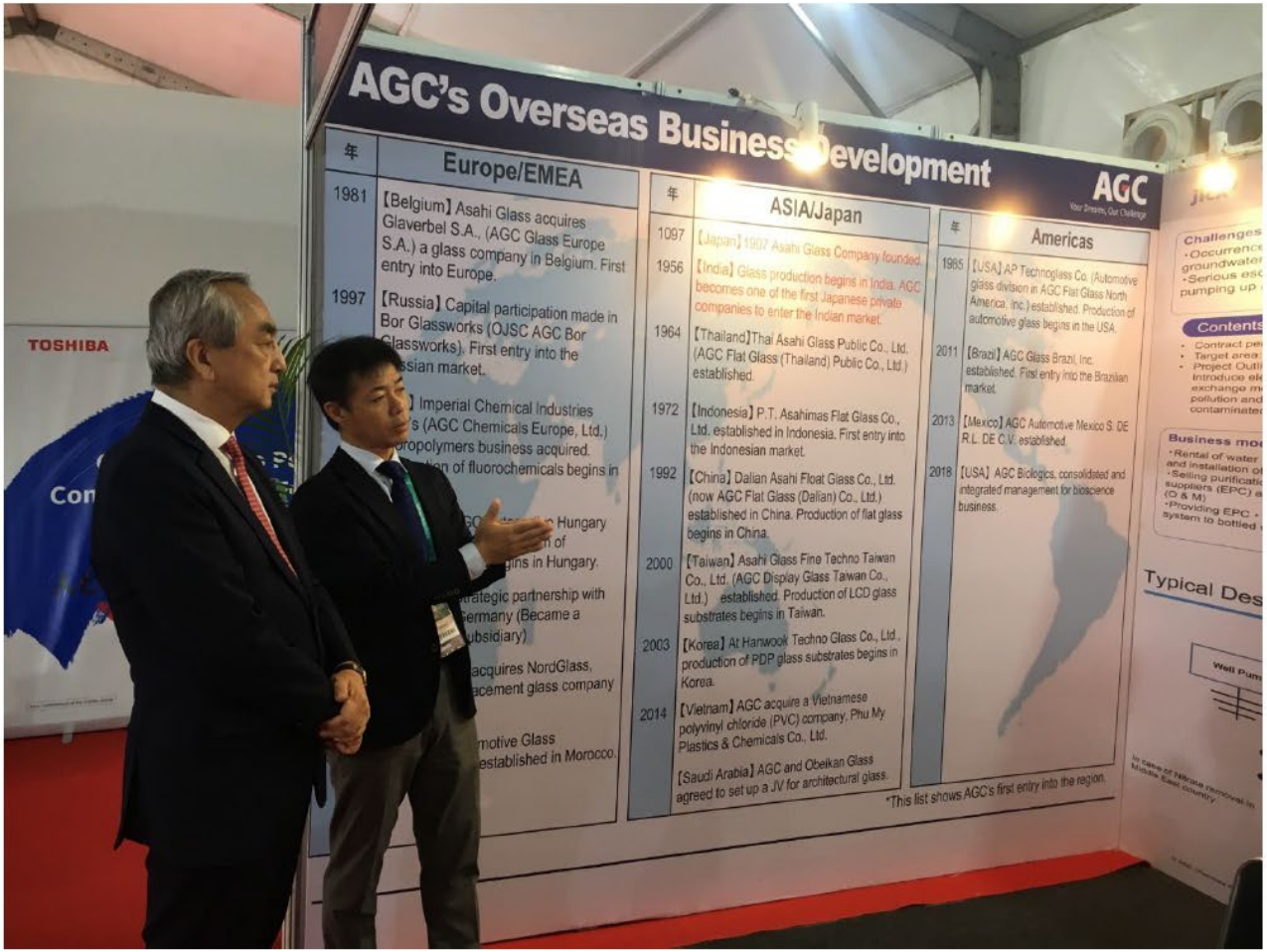
- President of India; Mr. Ram nath Kovind has inaugurated the ceremony.
- In his speech, he asked participants/audience to help & save the water through various means.

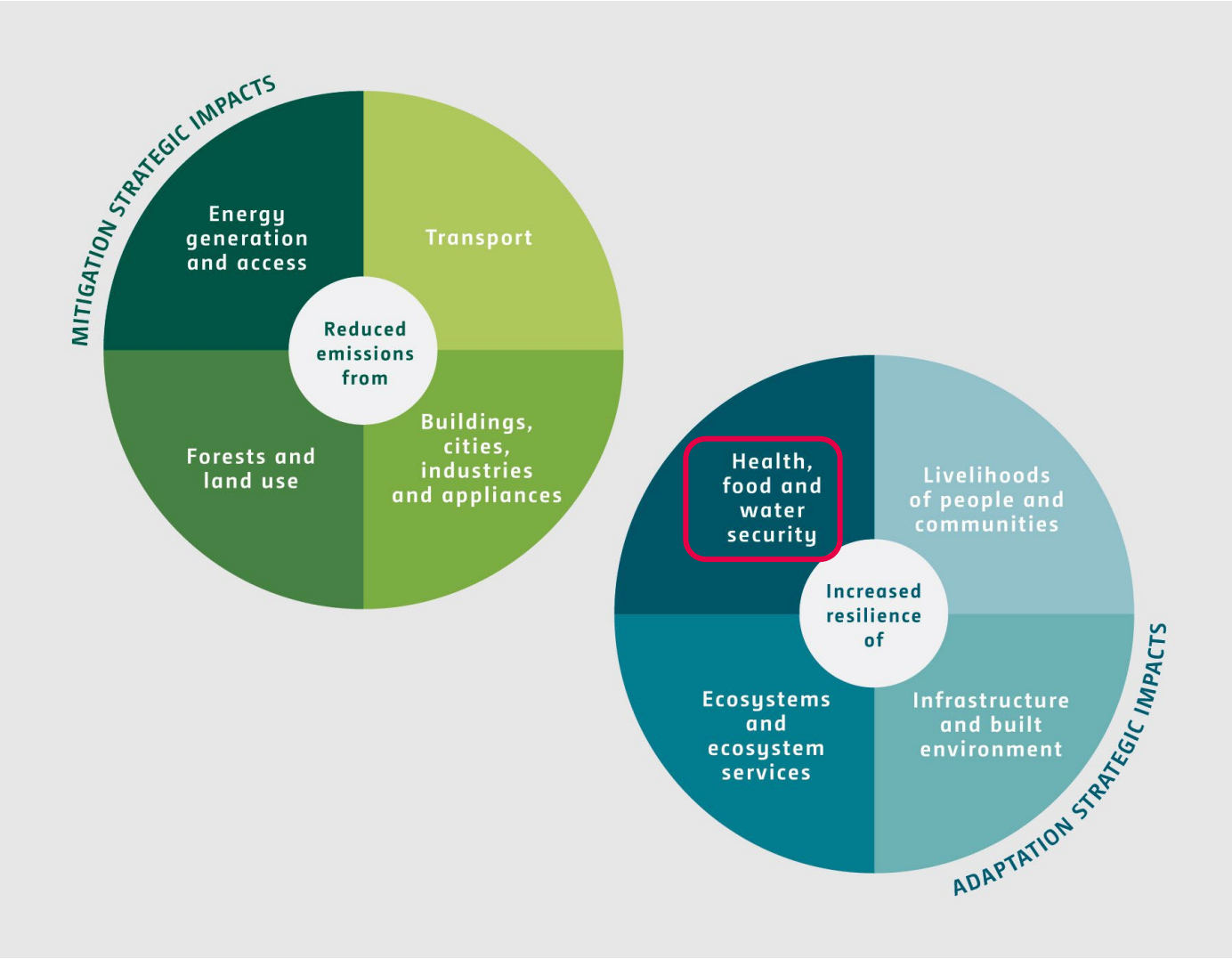
Japan ambassador at AGC booth



AAPI MD; Mr. Hisashi Takaso explaining AGC & its technology to Japan Ambassador; Mr Kenji Hiramatsu

Green Climate Fund

Detail information: https://www.greenclimate.fund/home



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